

Middle Grades Mathematics

5–9

Section 25

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1 Knowledge of mathematics through problem solving

1. Identify appropriate mathematical problems from real-world situations.
2. Apply problem-solving strategies to solve nonroutine problems with multiple steps.
3. Evaluate the reasonableness of results with respect to the original problem.
4. Use mathematics to solve problems in other contexts.

2 Knowledge of mathematical representations

1. Identify appropriate representations or models for mathematics operations or situations using written, concrete, pictorial, graphical, or algebraic methods.
2. Interpret results as illustrated by the use of mathematical representations.
3. Select appropriate manipulatives, mathematical models, or technology for teaching particular mathematics concepts (e.g., tiles for teaching area, graphing calculators for teaching algebra).

3 Knowledge of mathematics through reasoning

1. Identify deductive and inductive reasoning.
2. Identify valid mathematical arguments (e.g., an explanation that the sum of two odd numbers is always even).
3. Identify the hypothesis and conclusion, given a conditional statement.
4. Identify the converse, inverse, and contrapositive of a conditional statement.
5. Select logical conclusions from given statements.

4 Knowledge of mathematical connections

1. Identify prerequisite skills for a given topic.
2. Identify common misconceptions in mathematics (e.g., area and perimeter).
3. Identify the relationship between mathematical concepts (e.g., repeated addition and multiplication).
4. Identify mathematical errors, including computation, algebraic, data analysis, and geometric errors.

5. Analyze mathematical errors, including computation, algebraic, data analysis, and geometric errors.
6. Identify fundamental ideas that connect middle grades mathematics to advanced mathematics (e.g., trigonometry, number theory, precalculus, calculus).

5 Knowledge of number sense, concepts, and operations

1. Identify elements and subsets of the real number system.
2. Compare the relative size of real numbers expressed in a variety of forms, including fractions, decimals, percents, and scientific notation.
3. Identify estimation strategies.
4. Simplify expressions using the laws of exponents.
5. Identify equivalent forms of rational exponents and radicals.
6. Simplify radical expressions.
7. Determine the prime factorization of composite numbers.
8. Identify the greatest common factor (GCF) and least common multiple (LCM) of sets of numbers.
9. Evaluate numerical expressions using order of operations.
10. Solve real-world problems using proportions.
11. Solve real-world problems that involve real numbers.

6 Knowledge of algebraic thinking

1. Predict missing or subsequent terms in numerical, algebraic, and pictorial patterns.
2. Analyze relationships between tables, graphs, or rules.
3. Analyze relationships to determine the impact when changing parameters of given functions.
4. Simplify rational and irrational expressions.
5. Solve equations or inequalities with one variable, including absolute values.

6. Identify matrices that represent data provided by real-world or mathematical problems.
7. Identify graphs of first-degree inequalities involving one variable on a number line.
8. Identify graphs of linear equations or inequalities involving two variables on the coordinate plane.
9. Identify the slope and intercepts of a graph or an equation.
10. Identify the interpretation of the slope and intercepts, given a real-world context.
11. Identify the equation of a line that is perpendicular or parallel to a given line.
12. Determine an equation of a line.
13. Determine the greatest common monomial factor of a polynomial.
14. Factor polynomials.
15. Solve systems of linear equations involving two variables using graphing, substitution, or elimination.
16. Determine the solution set of a system of linear inequalities involving two variables.
17. Solve quadratic equations and inequalities by completing the square, the quadratic formula, and factoring.
18. Use the discriminant or a graph of a quadratic equation to determine the nature of its real solutions (zero, one, two).
19. Identify the graph of quadratic functions.
20. Identify graphs of relations involving quadratic inequalities.
21. Solve equations involving radicals, limited to square roots.
22. Identify the domain and range of specified functions.
23. Identify quadratic equations or inequalities for solving real-world problems.
24. Identify equations or inequalities that could be used to solve real-world and mathematical problems involving one or two variables.
25. Identify properties (e.g., commutative, associative, distributive).

7 Knowledge of data analysis and probability

1. Compute the mean, median, mode, and range of a set of data.
2. Determine whether the mean, median, or mode is the most appropriate measure of central tendency in a given situation.
3. Interpret information (e.g., correlation, regression, distributions) from various graphic representations.
4. Identify appropriate graphical representations for a given data set.
5. Determine probabilities of dependent or independent events.
6. Predict odds of a given outcome.
7. Identify an appropriate sample space to determine the probability of a given event.
8. Make predictions that are based on experimental or theoretical probabilities.
9. Apply counting principles to solve real-world problems.

8 Knowledge of geometry and spatial sense

1. Identify angles or pairs of angles as adjacent, complementary, supplementary, vertical, corresponding, alternate interior, alternate exterior, obtuse, acute, or right.
2. Identify lines and planes as perpendicular, intersecting, skew, or parallel.
3. Identify triangles using the lengths of their sides or the measures of their angles.
4. Determine the sum of the measures of the interior angles and the sum of the measures of the exterior angles of convex polygons.
5. Determine the measures of the specified interior or exterior angles of a triangle or a regular polygon.
6. Apply the inequality relationships among the angles and sides of a triangle.
7. Use the SAS, ASA, and SSS postulates to show pairs of triangles congruent, including the case of overlapping triangles.
8. Solve real-world problems involving similar or congruent figures.
9. Solve real-world problems applying the Pythagorean theorem and its converse.
10. Solve real-world problems by applying the 30° – 60° – 90° or 45° – 45° – 90° triangle relationships.

11. Solve right triangle problems by applying tangent, sine, or cosine ratios.
12. Apply the properties of parallelograms, rectangles, rhombuses, squares, or trapezoids.
13. Apply the distance formula.
14. Apply the formula for midpoint.
15. Identify the coordinates of the vertices of a given polygon when it lies in the coordinate plane.
16. Identify point, line, and plane as undefined terms and symbols for lines, segments, rays, and distances.
17. Identify transformations, dilations, or symmetry of geometric figures.
18. Identify characteristics of three-dimensional figures.
19. Identify the net of a three-dimensional figure.
20. Identify figures that tessellate.
21. Identify the two-dimensional view of a three-dimensional object.

9 Knowledge of measurement

1. Determine appropriate units and instruments for measuring a given quantity in a real-world context.
2. Estimate measurements, including length, area, volume, weight, time, temperature, and money.
3. Make conversions within the metric or customary systems in a real-world context.
4. Apply the formulas for determining the circumferences and areas of circles in a real-world context.
5. Find the perimeter or area of figures composed of parallelograms, triangles, circles, and trapezoids in a real-world context.
6. Apply the formulas for surface area and volume to right prisms, regular pyramids, right circular cylinders, cones, and spheres in a real-world context.
7. Determine how a change in such dimensions as length, width, height, or radius affects other measurements such as perimeter, area, surface area, and volume.
8. Solve problems involving direct or indirect measurement.

9. Solve real-world problems using money, rates, distance, time, temperature, and angle measures.
10. Interpret scale drawings such as those based on number lines and maps to solve real-world problems.